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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

April 30, 1998

Magalie Roman Salas, Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, DC 20554

RE: Ex Parte Filing, WT 96-86

Dear Ms. Salas:

On April 2, 1998 Ericsson Inc, Private Radio Systems was scheduled to make an ex parte presentation to various members of the Wireless Telecommunications Bureau regarding the above referenced proceeding. Through nobody's fault, the meeting scheduled for April 2nd had to be postponed until some future date. Unfortunately, much of what would have been discussed on the 2nd is still germane and should be of assistance to the Bureau as it addresses certain issues in the above referenced proceeding.

Attached is a discussion of some of the issues that would have been discussed at the meeting on April 2nd, which we request be filed as an ex parte input in this proceeding.

If there are any questions, please do not hesitate to contact me.

Very truly yours,

Dr. Lars-Goran Larsson

Cc: John Clark
Kathryn Hosford

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List ABCDE

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

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MAY - 1 1998

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
The Development of Operational,	)	
Technical and Spectrum Requirements	)	
For Meeting Federal, State and Local	)	WT Docket No. 96-86
Public Safety Agency Communication	)	
Requirements Through the Year 2010	)	
	)	
Establishment of Rules and Requirements	)	
For Priority Access Service	)	

Ex Parte Filing of Ericsson Inc. to the Second NPRM

April 30, 1998

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INTRODUCTION

Ericsson supports the basic channelization approach and the minimal technical/operation rules proposed by Motorola[1] for the general use spectrum. The approach and rules proposed should promote efficient use of this spectrum. However, before Ericsson could support the specific coupled powers values proposed, as we indicated previously[2], a detailed understanding of the analyses included in the Technical Recommendations Appendix of the comments of Motorola plus other more detailed supporting analyses not included in the appendix, was necessary.

The Ex Parte filing by Motorola[3] provides additional information for understanding the background and supporting analyses regarding some of the proposed values. In this Ex Parte filing, Ericsson wishes to provide additional information relevant to the proposed coupled power requirement values.

Furthermore we have become aware of additional National Public Safety Telecommunications Council (NPSTC) deliberations[4] including modifications to the original proposed Motorola channel plan. In this filing, Ericsson will review its' concerns about these latest NPSTC inputs, particularly the modifications to the proposed Motorola channel plan.

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[1] R. C. Barth, "Comments of Motorola to the Second NPRM—WT Docket No. 96-86," Motorola, Inc., December 22, 1997.

[2] L.G. Larsson, "Reply Comments of Ericsson Inc. – WT Docket No. 96-86," Ericsson Inc., January 26, 1998

[3] M. A. Lewis, Comments and Charts by Motorola—WT Docket No. 96-86, Wiley, Rein, & Fielding, March 20, 1998.

[4] J. S. Powell, Electronic Mail and Power Point Presentation Files re WT Docket No. 96-86; "Spectrum Allocation Recommendations for the Public Safety portion of 746-806 MHz," PS764NEW.PPT, March 26, 1998; Original Motorola and NPSTC Comparisons, COMPARE2.PPT; Electronic Mail, April 8, 1998.

I. CHANNELIZATION

Ericsson supports minimal technical/operation rules that inherently provide flexibility to accommodate application of multiple technologies in private radio equipment as an efficient means of accomodating varied users' needs. Ericsson believes that there should be an assessment of current, emerging, and future technologies to determine if the technical/operation rules proposed are consistent with these various technologies. If certain of these technologies are not consistent with the proposed rules, limitations in application of these technologies should be understood and accepted and/or modifications to the rules proposed in order to accommodate these technologies should be determined.

In this current proceeding, the proposed rules should, as a minimum, consider application of the following products and technologies: Motorola Smartnet, Astro, and iDEN; Ericsson EDACS and Prism TDMA; other LMR manufacturers products; APCO Project 25 Phase I and Phase II; TETRA; and cellular/PCS AMPS, D-AMPS/TDMA, and GSM. Also, the evolution of the forementioned technologies currently under developement must also be considered. In particular, Ericsson believes that the current, emerging, and future cellular/PCS technologies should be well understood and that the proposed rules should not prevent or limit the application of these technologies to this band. A major thrust of on-going cellular developments is to provide high-speed data services. In light of the increasing interest in and demand for high-speed data by public safety licensees it is vitally important to understand all high-speed data developments to assure the technical/operation rules adopted accommodate application of these technologies in this band.

It is estimated that the on-going R&D investment in cellular/PCS technologies is at least 50 times larger than the R&D investment in US public safety radio/system technologies. Unique public safety channelization and performance requirements, unnecessarily limits leverage of cellular/PCS R&D into public safety products/systems. One consequence of this situation is the continued high cost of public safety products and systems compared to cellular/PCS products—for example, the approximate list price for a high end public safety portable radio is over $3000 versus a D-AMPS dual-band cellular phone for under $300. From another perspective, one estimate of the total North America trunked, high end public safety market in the year 2002 is a less than $2 billion dollars. Using this figure and a 7.5% average R&D investment as a percentage of sales, the total R&D investment for the industry serving this market would be $150 million dollars per year maximum. While this seems like a large number compared to the cellular/PCS industry that is investing over $7.5 billion dollars per year in R&D, it is miniscule. To stimulate technical and price competition in this public safety band, it is very important to establish technical/operation rules that neither prevent nor limit cellular/PCS technology leverage into public safety products/systems for this band.

Ericsson supports the Motorola proposed channel building block approach with building block increments of 6.25 kHz in the integrated voice/data segment and 100 kHz in the wideband segment. **Ericsson's support of this proposal is predicated on the adoption of rules that routinely allow aggregation of blocks on a frequency coordinated basis as needs dictate in order to accommodate multiple technologies and multiple users' needs.**

The recent NPSTC deliberations, previously noted herein, appear to be less flexible and more restrictive than the original Motorola proposal. The integrated voice/data segment channel plan is designed to accommodate 12.5 kHz, 25 kHz, and possibly 6.25 kHz transmitters, but may prevent or limit the applicability of transmitters/systems of other bandwidths. As an example of this potential limitation, consider an AMPS/D-AMPS transmitter/system where in normal application the channelization is 30 kHz. In the Motorola plan, five, 6.25 kHz blocks could be aggregated to create channels 31.25 kHz wide for D-AMPS operation. However, in the NPSTC plan, with the rules to "allow aggregation/disaggregation only on specific centers" and to "initially allocate based upon 12.5 kHz channel centers," three 12.5 kHz or six 6.25 kHz blocks would have to be aggregated to create channels 37.5 kHz wide for D-AMPS operation. These NPSTC proposed rules thus create channels wider than is necessary for D-AMPS operation, which unnecessarily reduces the spectrum efficiency by 17% and puts D-AMPS at a disadvantage. If allocation is allowed on 6.25 kHz channel centers in the NPSTC plan, then it appears that five, 6.25 kHz blocks could be aggregated to create 31.25 kHz channels for D-AMPS operation as in the Motorola plan, however, it is not clear whether 6.25 kHz channel centers are "specific centers" within the NPSTC definition. The other technologies/products previously indicated should also be assessed for application flexibility with the proposed NPSTC channel plan.

Similarly in the wideband operations segment, the NPSTC channel plan with the 125 kHz building blocks appears to be less flexible and more restrictive than the Motorola plan with 100 kHz building blocks. As an example, consider a GSM transmitter/system which in normal application, has channels 200 kHz wide. In the Motorola plan, two, 100 kHz blocks could be aggregated to create channels 200 kHz wide for GSM operation. However, in the NPSTC plan, two 125 kHz blocks would have to be aggregated to create channels 250 kHz wide for GSM operation. While as will be discussed in the next section on adjacent channel coupled power, the 250 kHz channel may not be unreasonable for the current GSM modulation, the 200 kHz channel will be more spectrum efficient for the more spectrally efficient modulations currently under development. As before, the other technologies/products previously indicated should also be assessed for application flexibility with the proposed NPSTC channel plan.

In general, flexibility, efficiency, and broad applicability of the spectrum increases as the building block increment size decreases. The tradeoff is to balance the benefit of smaller building block increments in terms of flexibility and efficiency versus the administration and coordination complications. One could argue that a 3.125 kHz building block increment would yield more flexibility and efficiency, but the Motorola proposed 6.25 kHz increment seems to be a reasonable balance with the administration/coordination complications.

II. TRANSMITTER COUPLED POWER REQUIREMENTS

Ericsson also supports the overall proposed interference specification approach based on the industry-preferred concept of "coupled power" rather than the historical use of emission mask requirements. The proposed "coupled power" specifications define requirements that more directly relate to overall system design parameters and should result in systems that operate with more predictable and lower levels of interference.

However, Ericsson believes that further analysis is necessary to understand the differences in 6.25/12.5/25 kHz transmitter spectrum design requirements between the emission mask requirement approach (47 CFR 90.210 e, d, g & h) and the proposed coupled power requirement approach. A number of 6.25/12.5/25 kHz transmitters made by different manufacturers have been designed to meet the existing emission masks in the various Public Safety bands and these manufacturers expect to frequency translate and use these transmitters in this new band. Any transmitter design changes or limitations resulting from specific coupled power values on adjacent channel usage should be well understood before endorsing the proposed specific coupled power values.

Further, Ericsson also believes current and emerging technologies/products should be assessed to determine if these technologies/products meet the proposed coupled power requirements.

a. Integrated Voice/Data Segment

To illustrate the need that further analysis is needed before specific coupled power vlues are adopted, Ericsson has performed a quick assessment of the emission mask and adjacent channel coupled power performance for the following transmitters applicable to the integrated voice/data segment: an Ericsson Prism TDMA 12.5 kHz Transmitter, a Potential 12.5 kHz Transmitter, an Ericsson EDACS 25 kHz Transmitter, and an Ericsson D-AMPS 31.25 kHz Transmitter. The performance assessments for these transmitters are illustrated in Figures (1), (3), (4), and (5) respectively with the emission mask performance in part (a) of the figures and the adjacent channel coupled power performance in part (b).

Figure (1) shows the performance for an experimental simulation of an Ericsson Prism TDMA 12.5 kHz transmitter where the experimental simulation consists of suitable test equipment with appropriate parameter settings. Figure (1a) shows the appropriate 90.210(d) emission mask performance and Figure (1b) shows the adjacent channel coupled power (ACCP) performance for the first two upper and lower adjacent 6.25 kHz bands. As can be noted for this case, the emission mask is satisfied with margin, but the ACCP for the first adjacent 6.25 kHz band exceeds the proposed –40dBc requirement value by nearly 7 dB. The ACCP for the second adjacent 6.25 kHz band meets the proposed –60dBc requirement value with a margin of 8-10 dB. This ACCP performance is likely better than will be measured for an actual transmitter because even in a high spec linearized transmitter, the small, residual non-linearity in the linearized power amplifier creates shoulder sidelobes that occur in these first adjacent 6.25 kHz bands. Typically these shoulder sidelobes are down about 20 dB from the peak of the main lobe without linearization and 40 dB down with linearization. With the shoulder sidelobes from the linearized transmitter, the emission mask would still be satisfied with margin, but the ACCP performance would be less than that illustrated. This simulation illustrates and actual transmitter measurements will show that the proposed ACCP requirement values are significantly more severe than the emission mask requirement on transmitter spectrum design. The result would be potentially less adjacent channel interference, but would require a re-design of existing transmitters that could and maybe should be applied in this new band..

The –40dBc requirement value for the first adjacent 6.25 kHz band is of significant concern to Ericsson. As indicated by this simulation example and by the other cases later, this value would require re-design of the transmitters or would require upper and lower 6.25 kHz guard bands. With these guard bands, a high performance 12.5 kHz transmitter would effectively be restricted to be used in 25 kHz channels which Ericsson believes is technically unjustified. This is one of the reasons Ericsson believes it is critically important to understand the background and supporting analyses that led to the proposed values. Ericsson believes that this proposed value could be relaxed and still provide adequate adjacent channel interference protection. The Motorola spectrum efficiency optimization results versus ACCP[5] show a relative broad optimum ACCP region for both linear and constant envelope modulations. The resultant curves show -30 dB (or dBc) as the optimum value rather than the proposed –40dBc value.

Another concern is whether the ACCP measurement as proposed over the entire adjacent 6.25 kHz band is representative of the actual relative power that will be intercepted by and cause interference to a receiver on an adjacent channel. It is likely that the effective bandwidth of a receiver on the adjacent 6.25 kHz (or 12.5 kHz) channel will be less than the total channel width and consequently will only intercept coupled power from a portion of the channel or band. If the power density is nearly constant across the measurement band, the proposed ACCP measurement is representative and can be modified to the effective receiver bandwidth through simple scaling. However, if the power density changes significantly near the edges of the measurement band, then the measured power over the total band will not be representative of the actual intercepted power in the effective receiver bandwidth. This situation is illustrated in Figure (1) where

[5] M. A. Lewis, Comments and Charts by Motorola—WT Docket No. 96-86, Wiley, Rein, & Fielding, March 20, 1998, "Reason for Proposing Adjacent Channel Coordination Part3: Maximum Overall Spectrum Efficiency."

the edge of the power spectral density main lobe occurs in the edge of the first adjacent 6.25 kHz band. The sensitivity of the ACCP measurement as a function of the measurement bandwidth, around the center of the first and second adjacent 6.25 kHz bands, is illustrated in Figure (2). As expected, the results show high sensitivity in the first adjacent 6.25 kHz band due to the edge of the power density main lobe and low sensitivity in the second adjacent 6.25 kHz band where the power density has less change across the band. As indicated in Figure (2), the ACCP would meet the requirement value of –40 dB if the measurement bandwidth was 5.5 kHz rather than 6.25 kHz. The actual intercepted power by a receiver in an adjacent 6.25 or 12.5 kHz band will be much less, perhaps 10-15 dB, than the ACCP measured over the entire band.

The challenge is to determine a suitable value for the intercepted adjacent band power that will cause interference to an adjacent channel receiver and then to translate this value into a corresponding ACCP requirement value. Ericsson believes that further detailed analysis is required to establish an appropriate intercepted adjacent band power value and to translate this value to a corresponding ACCP requirement value. However, prior to having analysis results, Ericsson believes that the –40dB ACCP value as specified and measured for the first adjacent 6.25 kHz band is overly stringent and would require unnecessary transmitter re-design. Similar assessment and analysis needs to be performed relative to the –60 dB ACCP values as specified for the second adjacent 6.25 kHz band. To make the ACCP measurement values more similar to the expected intercepted adjacent band power, a measurement in a representative receiver bandwidth around the adjacent channel band centers could also be considered and implemented. With modern spectrum analyzers, measurement of the band power for any measurement band around any frequency is easily performed.

Figure (3) shows the performance for an experimental simulation of a potential 12.5 kHz transmitter where the experimental simulation consists of suitable test equipment with appropriate parameter settings. This particular set of parameters does not correspond to any known transmitter, but represents a potential transmitter where the transmit spectrum nearly fills the emission mask skirts. The emission mask performance is illustrated in Figure (3a) and the ACCP performance for the first three upper and lower adjacent 6.25 kHz bands is illustrated in Figure (3b). As can be noted for this case, the emission mask is satisfied with some small margin, but the ACCP for the first adjacent 6.25 kHz band exceeds the proposed –40dBc requirement value by 14-15 dB. Further, the ACCP for the second and third adjacent 6.25 kHz bands exceeds the proposed –60dBc requirement value by about 4 dB. Although this is a hypothetical transmitter, it illustrates again that the proposed ACCP requirement values are much more stringent than the current emission mask on transmitter spectrum design and on the corresponding ACCP. This case further supports the need for a thorough analysis to develop appropriate ACCP requirement values and perhaps a more appropriate measurement method.

Figure (4) shows the performance for an Ericsson EDACS 25 kHz transmitter based on experimental measurements of a 100 W Mastr III basestation with standard parameters used for operation in normal 25 kHz, 800 MHz channels. Figure (4a) shows the appropriate 90.210(g) emission mask performance and Figure (4b) shows the ACCP performance for the first two upper and lower adjacent 6.25 kHz bands. As can be noted, the emission mask is satisfied with margin and the ACCP for the first adjacent 6.25 kHz band meets the proposed –40dBc requirement value with a margin of about 8 dB, but the ACCP for the second adjacent 6.25 kHz band exceeds the proposed –60dBc requirement value by about 2 dB. In this case, the transmitter would have to be re-designed with additional filtering to meet the proposed –60dBc requirement.

Figure (5) shows the performance for an Ericsson D-AMPS 31.25 kHz transmitter based on experimental measurements of a 30 W RBS 884 basestation transceiver module with standard parameters used for operation in normal 30 kHz cellular channels. As for the Ericsson Prism TDMA transmitter, the RBS 884 transceiver employs a linearized power amplifier to support the linear D-AMPS modulation. The linearization was in operation for the measurements shown here. As previously indicated, five, 6.25 kHz building blocks were aggregated to create a 31.25 kHz channel with the modulation centered in the channel. Figure (5a) shows an emission mask performance illustration for a case where the Economic Area upper and lower end masks per 90.691 are applied at the upper and lower edges of the 31.25 kHz channel. It is recognized that these end masks apply strictly speaking to the "upper 200" channels of the SMR spectrum, but in some other cases blocks of 25 kHz channels have been re-channelized into wider channels with the end masks applied at the edges of the block similar to the illustration here. Figure (5b) shows the ACCP performance for the first five upper and lower adjacent 6.25 kHz bands. As indicated, the ACCP for the first adjacent 6.25 kHz band exceeds the proposed –40 dBc requirement value by nearly 5 dB and the ACCP for the second adjacent 6.25 kHz band exceeds the proposed –60dBc requirement value by 4-5 dB. The ACCP for the upper and lower 25 kHz bands just outside the two adjacent 6.25 kHz bands can be reasonably estimated from the last three 6.25 kHz band measurements in Figure (5b) to be

–57.5 and –57.9 dB respectively which exceed the proposed requirement value of –60 dBc value 2-3 dB. Again, in the first adjacent 6.25 kHz band, the edges of the main lobe contribute significantly to the measured ACCP, but may not contribute to significant intercepted power by a receiver in the adjacent 6.25 or 12.5 kHz band with an effective bandwidth less than the band. Also, as previously described, the shoulder sidelobe resulting from the small residual non-linearity in the transmitter contributes to the ACCP in the first four adjacent 6.25 kHz bands. The RBS 884 transceiver is a modern, high spec design with the shoulder sidelobe down over 40 dB from the spectrum peak. Additional improvement in the shoulder sidelobe level would require an extensive transmitter re-design to meet the proposed ACCP requirement values. Use of the transmitter with the currently proposed requirements would require upper and lower 6.25 kHz guard bands for a total channel with of 43.75 kHz. With these guard bands, a high performance 31.25 kHz transmitter would effectively be restricted to be used in 43.75 kHz channels, which Ericsson believes, is technically unjustified. These results further show that a careful analysis is required to establish ACCP requirement values that provide adequate adjacent channel interference protection, but don't place overly restrictive requirements on the transmitter design.

b. Wideband Operations Segment

Ericsson has performed a quick assessment of the ACCP performance for a GSM transmitter applicable to the wideband operations segment. Figure (6) shows the performance for an experimental simulation of a GSM 200 kHz transmitter where the experimental simulation consists of suitable test equipment with appropriate parameter settings. The ACCP performance is shown for the first four 100 kHz bands adjacent to the 200 kHz on-channel band, which is comprised of two aggregated 100 kHz building blocks. As can be seen, the ACCP for the first adjacent 100 kHz band exceeds the modified proposed requirement value of –30 dBc by nearly 12 dB. The ACCP for the next three adjacent 100 kHz bands meets the proposed requirement value of –50 dBc with margins of 4 to 15 dB. With the 12 dB miss of the first adjacent channel requirement, it may be necessary to aggregate three, 100 kHz building blocks to create a 300 kHz channel for suitable operation. In this case, with the normal GSM modulation, the aggegation of two NPSTC 125 kHz building blocks to create a 250 kHz channel may be reasonable. However, for future modulations currently under development, the 200 kHz channel will be more spectrum efficient. As previously indicated, Ericsson recommends assessment of other wideband technologies/products under development as part of the process to establish the channelization and ACCP requirement values.

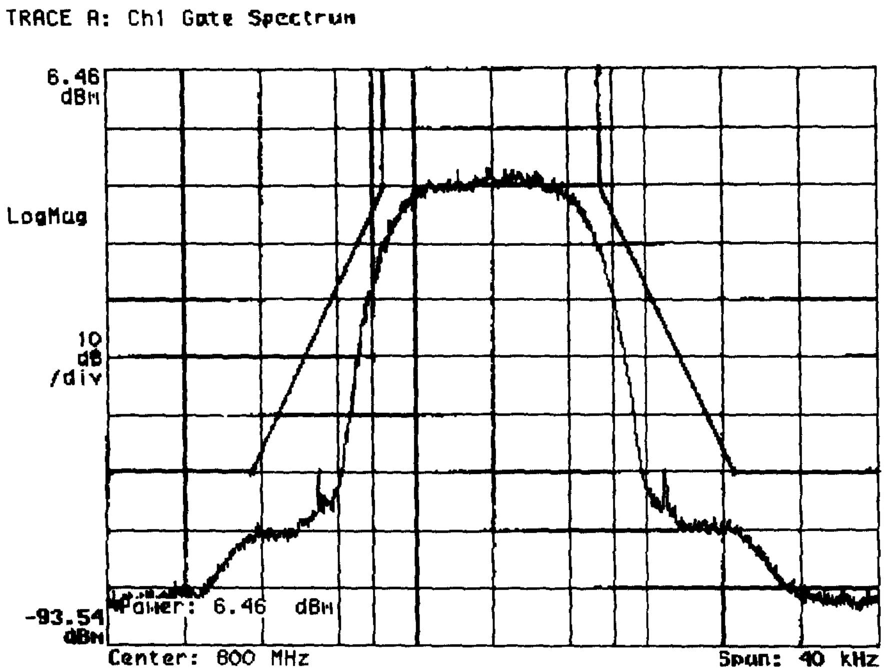
c. Mobile Station Absolute Coupled Power

Ericsson believes that further understanding of the background and supporting analysis for the Maximum Coupled Power at Maximum Tx Power requirement values proposed is necessary. In particular, further understanding of the background and supporting analysis is necessary for the proposed –45/35 dBm requirement values for the first few adjacent building block channels for the integrated voice/data and wideband segments respectively.

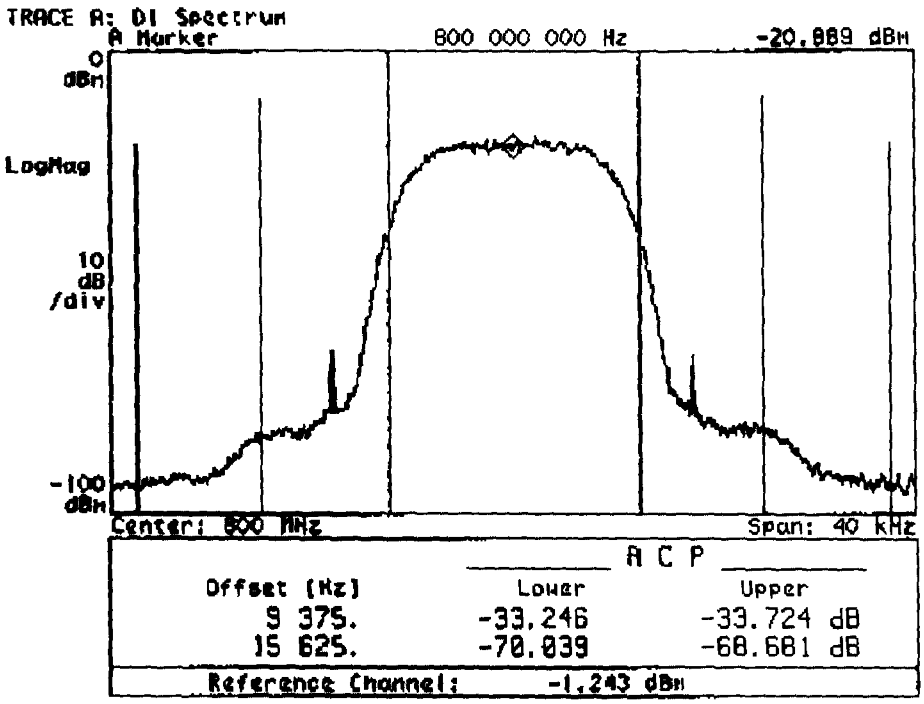
To meet the absolute coupled power requirement of –45 dBm into the second adjacent channel for a 30 W mobile with the maximum coupled power of –60 dB, it appears that a mobile power control dynamic range of 30 dB would be required. This seems to be a larger than the desired dynamic range for low risk, reliable, practical implementation.

III. CONCLUSION/SUMMARY

While Ericsson supports the overall approach and the minimal technical/operations rules proposed by Motorola, Ericsson believes that the technical issues and suggestions discussed here should be addressed before a specific channeling plan and specific adjacent channel coupled power requirement values are adopted. Ericsson strongly suggests that expeditious technical dialogue, involving all interested parties, will achieve consensus on a channelization plan and performance requirement values that will best serve the needs of public safety in this band and in all Public Safety Bands.



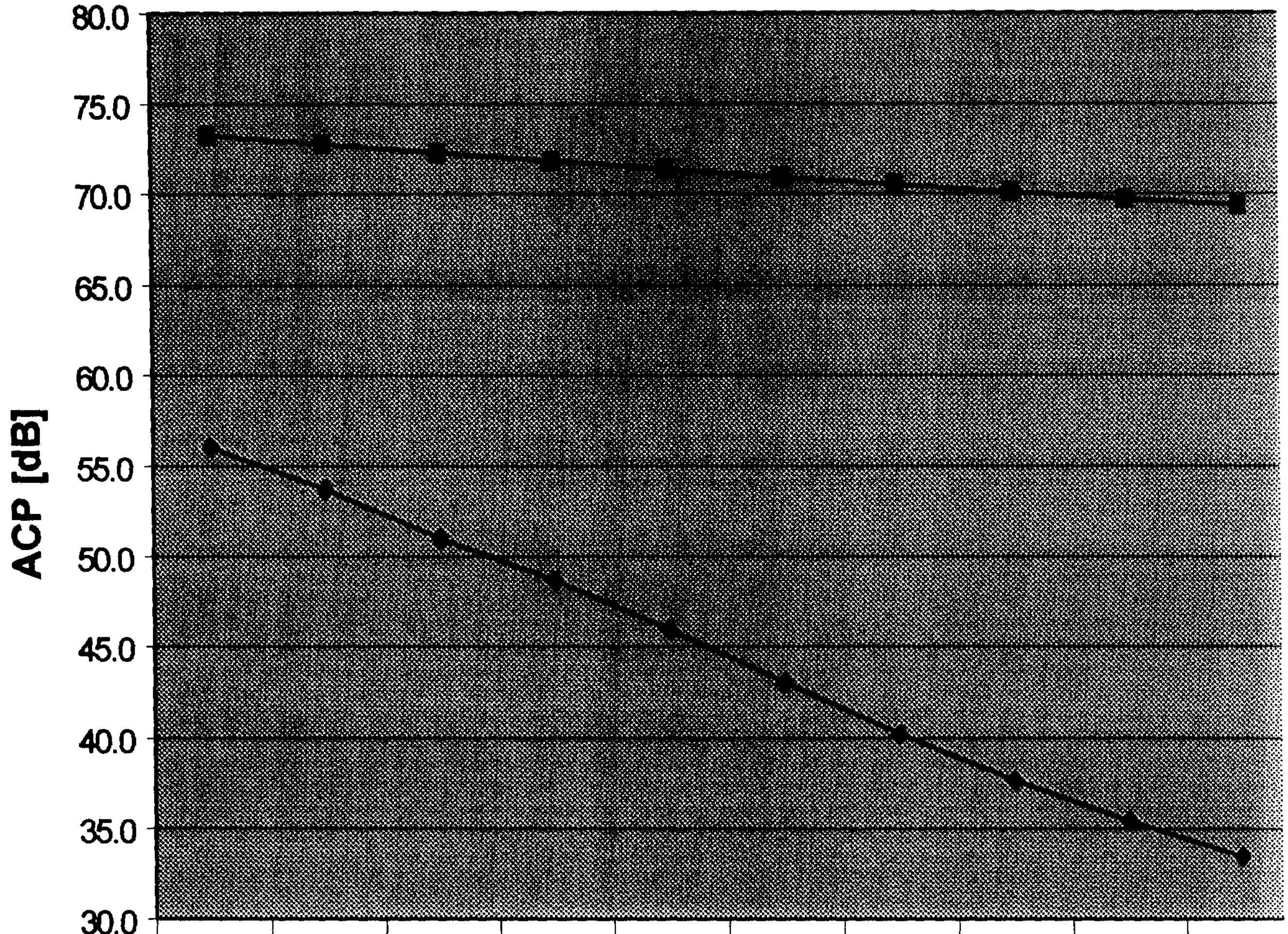
a) Emission Mask Performance (90.210d Mask)



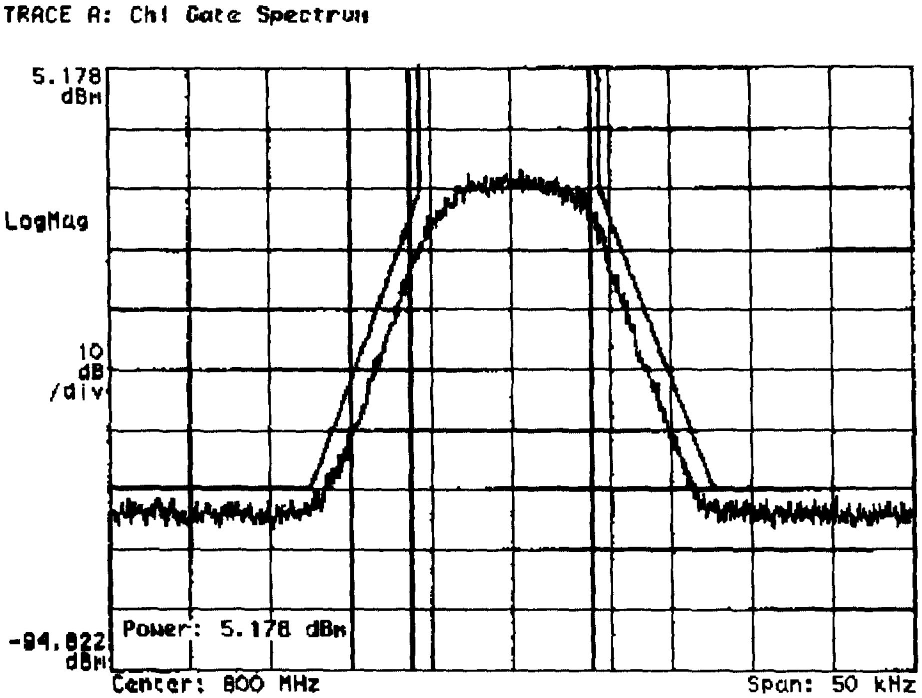
b) Adjacent Channel Coupled Power Performance (adjacent 6.25kHz bands)

Figure (1): Simulated Ericsson Prism TDMA 12.5 kHz Transmitter Performance: Experimental Simulation with Test Equipment

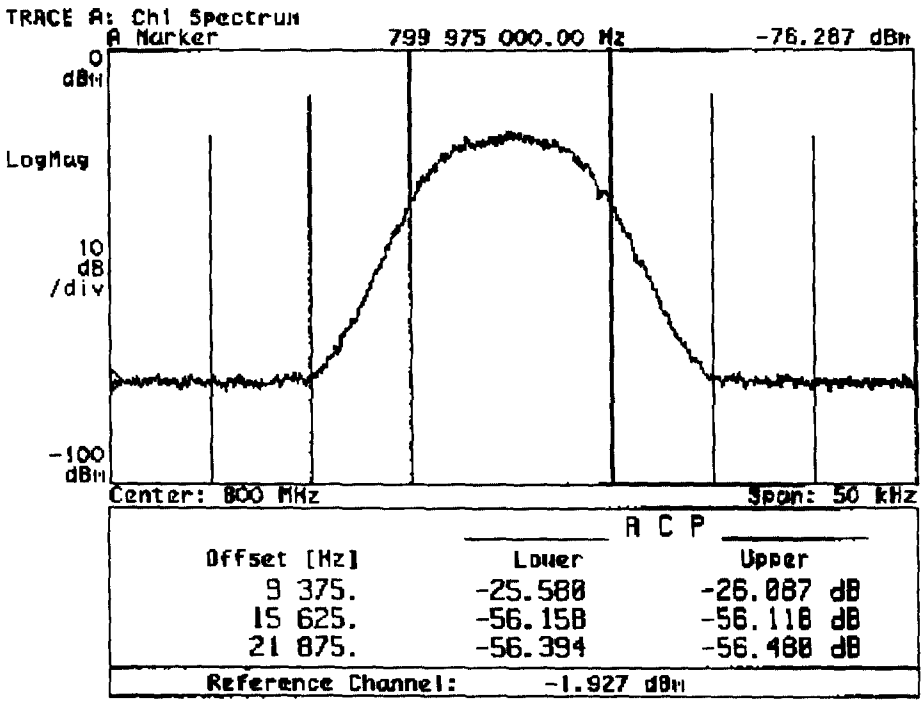
Figure (2) ACP Sensitivity to Adjacent Channel Measure Bandwidths for Prism



	4.00kHz	4.25kHz	4.50kHz	4.75kHz	5.00kHz	5.25kHz	5.50kHz	5.75kHz	6.00kHz	6.25kHz
1st Adj. Ch.	56.0	53.7	51.0	48.7	45.9	43.0	40.2	37.6	35.4	33.5
2nd Adj. Ch.	73.2	72.7	72.3	71.8	71.4	70.9	70.5	70.1	69.7	69.4

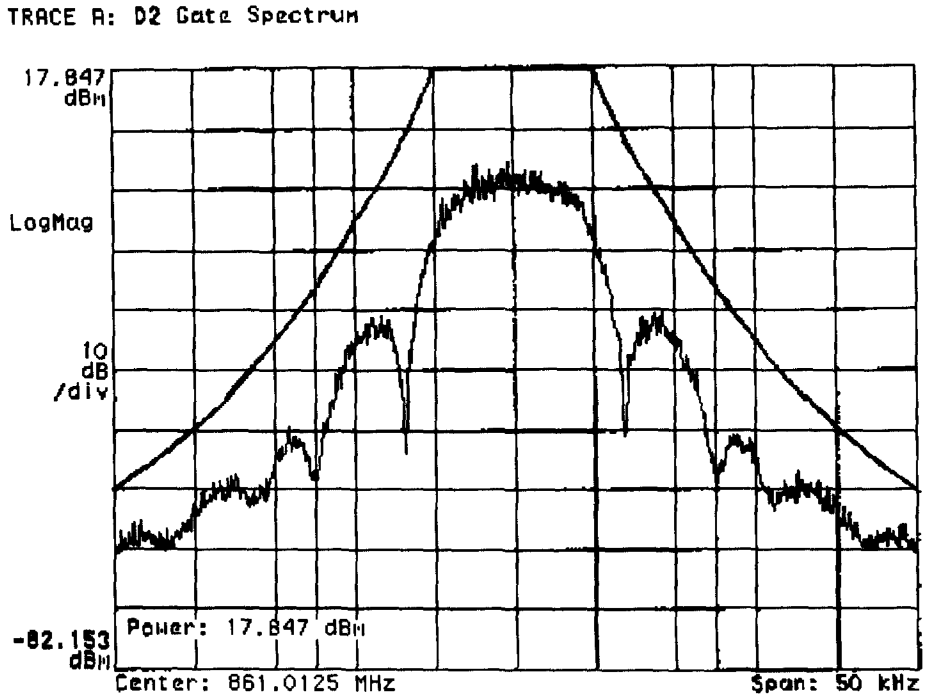


a) Emission Mask Performance (90.210d Mask)

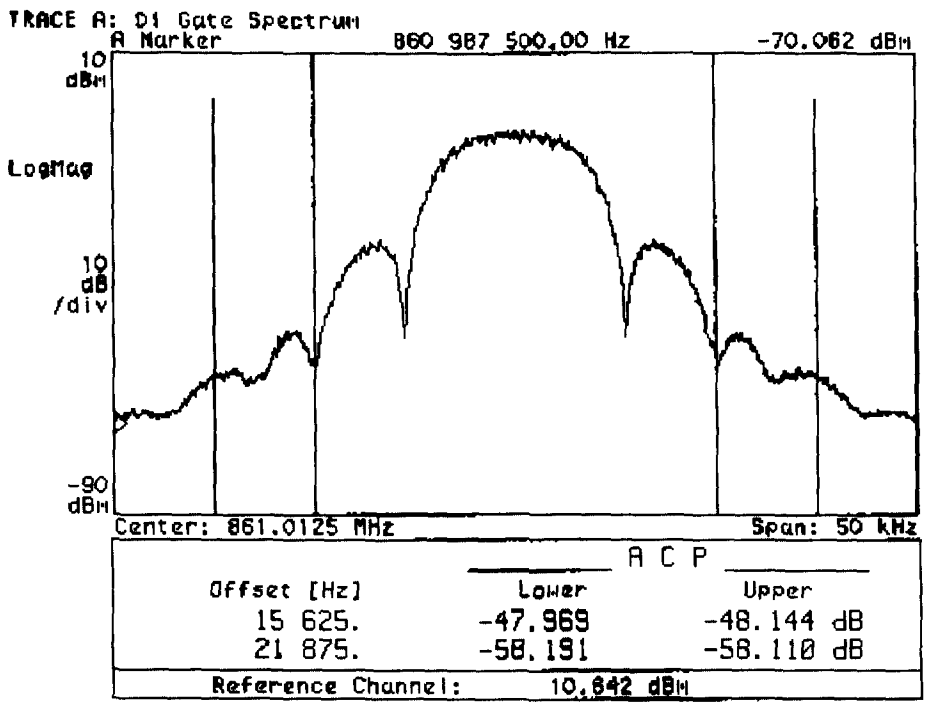


b) Adjacent Channel Coupled Power Performance (adjacent 6.25 kHz bands)

Figure (3): Simulated Potential 12.5 kHz Transmitter Performance: Nearly Filled Mask Skirts: Experimental Simulation with Test Equipment

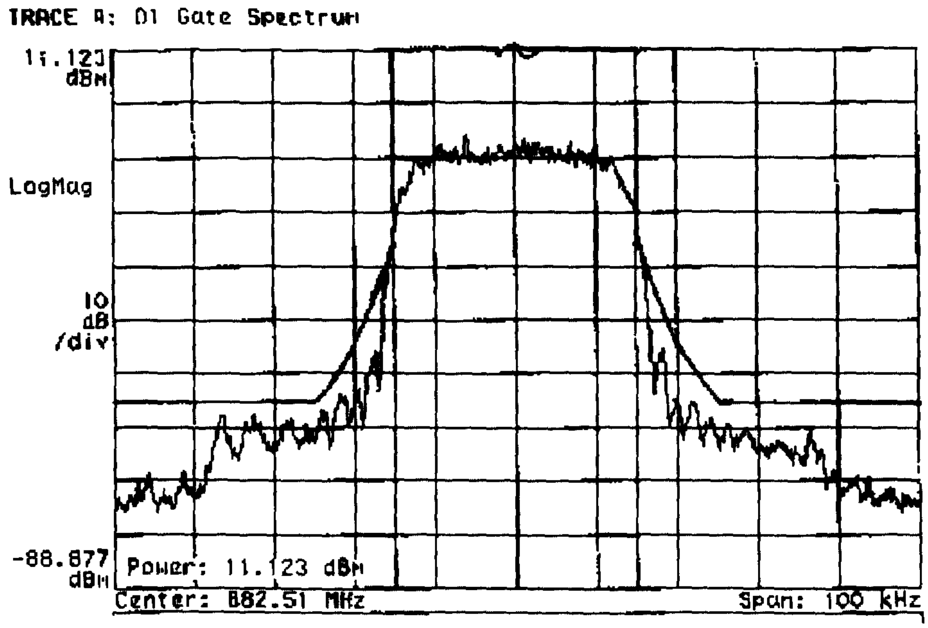


a) Emission Mask Performance (90.210g Mask)

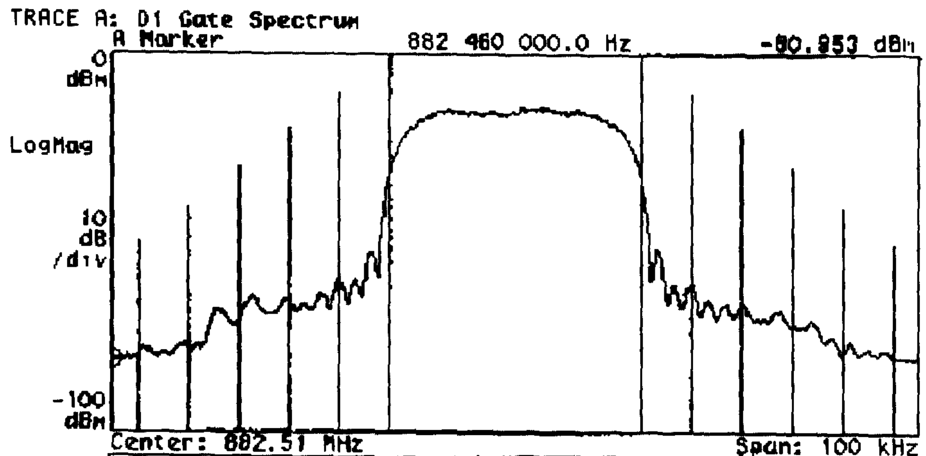


b) Adjacent Channel Coupled Power Performance (adjacent 6.25 kHz bands)

Figure (4) Measured Ericsson EDACS 25 kHz Transmitter Performance: Experimental Measurements of 100 W Mastr III Basestation



a) Emission Mask Performance Illustration (EA Upper/Lower End Mask per 90.691)



	A C P	
Offset [Hz]	Lower	Upper
18 750.	-35.382	-35.317 dB
25 000.	-55.947	-56.795 dB
31 250.	-57.608	-59.643 dB
37 500.	-62.162	-63.763 dB
43 750.	-69.298	-68.918 dB
Reference Channel:	3.781 dBm	

b) Adjacent Channel Coupled Power Performance (adjacent 6.25 kHz bands)

Figure (5): Measured D-AMPS IS136, 31.25 kHz Transmitter Performance: Experimental Measurements of Ericsson, IS136, 30W, RBS 884 Basestation Transceiver Module with Linearization: Five, 6.25 kHz Channels Aggregated for 31.25 kHz Channel

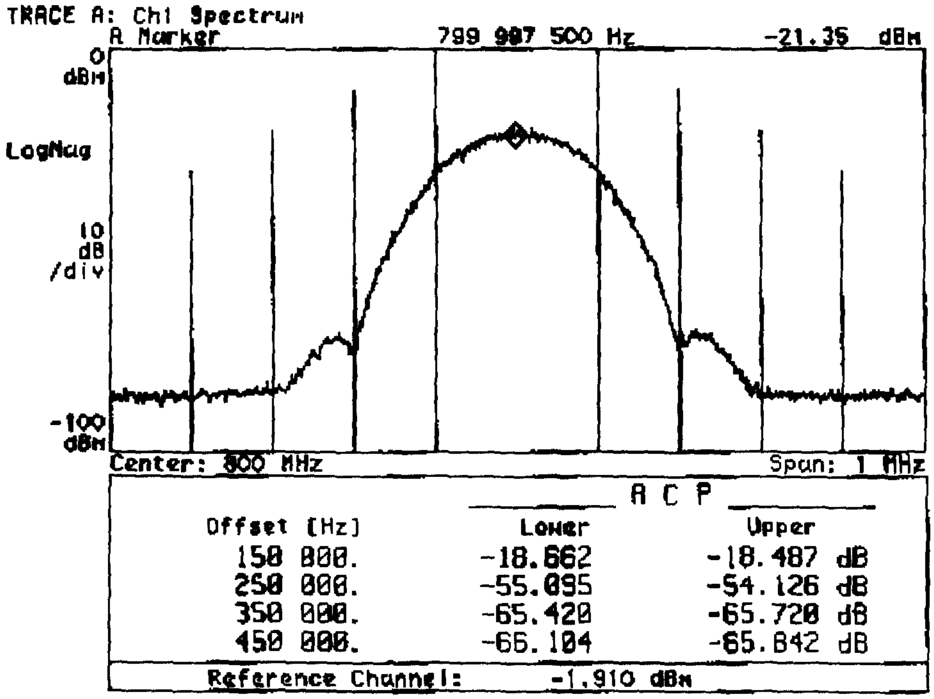


Figure (6): Simulated GSM 200 kHz Transmitter Performance: Experimental Simulation with Test Equipment